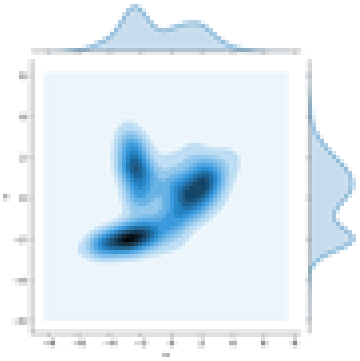
institute for pure & applied mathematics

Workshop III: Statistical and Numerical Methods for Non-commutative Optimal Transport

MAY 19-23, 2025



Scientific Overview

Many advanced techniques now exist to compute the numerical solution of an Optimal Transport problem, with rigorous guarantees. The methods emerge from the interaction between Optimal Transport and other important fields in applied mathematics such as statistics and numerical analysis. In particular, OT estimators have been developed in the commutative case with good guarantees, both for discrete measures [1,2,3] and for continuous probabilities [4]. The first approaches have already led to important applications in machine learning and deep learning. For the second, though statistical approaches achieving low error even in high dimension are known [5], their computational complexity is still of the order of ε^(-d/2) to achieve error ε on a d-dimensional problem. More recently, benefitting from the interaction with approximation theory and machine learning, a new family of methods has been devised that obtain a computational complexity of ε^(-4) for very smooth probabilities [6]. The methods cast the dual of the optimal transport problem in terms of a novel family of Sums-of-Squares optimization problems, which are not necessarily polynomials.

A function is a sum of squares (SOS) when it can be written as f(x) = φ(x)^* Aφ(x) for a map φ : X ⟶ C^n and A that is a positive semidefinite matrix. This allows representing a function that is non-negative, but still linear in the parameters. By using this model in a convex optimization problem on non-negative functions, the resulting problem is a semidefinite program (SDP). So in the particular case of the algorithm above, OT is represented in terms of a PSD matrix and can be formulated as an SDP.

The goal of the workshop is to foster the discussion at the intersection between OT and the numerical domains recalled above, and to explore the following open questions:

This workshop will include a poster session; a request for posters will be sent to registered participants before the workshop.

Participation

Additional information about this workshop including links to register and to apply for funding, can be found on the webpage listed below. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission, and we welcome their applications.

Organizers

Alessandro Rudi (Ecole Normale Supérieure)
Jonathan Niles-Weed (NYU)
Quentin Berthet (Google)

Invited Speakers

Sivaraman Balakrishnan (Carnegie Mellon University), Greg Blekherman (Georgia Institute of Technology), Venkat Chandrasekaran (California Institute of Technology), Promit Ghosal (University of Chicago), Soodeh Habibi (University of Liverpool), Didier Henrion (Centre National de la Recherche Scientifique), Anna Korba (École Nationale de la Statistique et de l'Administration Économique), Jean Lasserre (Université de Toulouse III), Giulia Luise (Microsoft Research AI, MIT), Tudor Manole (MIT & Arizona State University) Dávid Papp (North Carolina State University) Pablo Parrilo (Massachusetts Institute of Technology) Bodhisattva Sen (Columbia University)

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For more information, visit the program web page:
www.ipam.ucla.edu/NOTWS3